

AUTOECOLOGY AND DESCRIPTION OF *MUMMUCIA MAURYI* (SOLIFUGAE, MUMMUCIIDAE), A NEW SOLIFUGE FROM BRAZILIAN SEMI-ARID CAATINGA

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ABSTRACT. The Brazilian solifuge *Mummucia mauryi* new species (Solifugae, Mummuciidae) from sand dunes of the São Francisco River, in semiarid caatinga domain, is herein described, with illustrations of the main taxonomic characters. This is the first species of Solifugae described from the Brazilian caatinga. The specimens were collected in pitfall traps during both the rainy and dry seasons. It exhibits diurnal activity and a clumped distribution (Morisita's index = 3.32 and 1.38 for rainy and dry season, respectively). Sun-exposed areas were avoided during the dry season, when preference for the cactacean *Opuntia inamoena* was detected. We suggest this association is related to predator avoidance.

RESUMO. O solífugo *Mummucia mauryi* (Solifugae, Mummuciidae) é descrito a partir de exemplares coletados nas dunas interiores do Rio São Francisco (BA), com ilustrações dos principais caracteres taxonômicos. Esta é a primeira espécie de Solifugae descrita para o domínio da caatinga semi-árida. Estudos sobre a autoecologia indicam atividade diurna; distribuição do tipo agregado (índice de Morisita = 3.32 e 1.38 para as estações chuvosa e seca, respectivamente); preferência negativa por áreas mais expostas à insolação durante a estação seca e preferência pela cactácea *Opuntia inamoena*, o que sugerimos estar relacionado à proteção contra predadores.

Keywords: Arachnida, microhabitat, Solpugida, systematics

Knowledge of the order Solifugae in the Neotropical Region is very limited, especially for the portion of South America occupied by Brazil, which includes distinctive environments such as caatinga and cerrado. In this area, studies on Solifugae are scarce and there are a few distributional records, some of which were unfortunately excluded from some world maps (Savory 1964; Punzo 1998). Maury (1984) comprehensively listed and annotated all Brazilian records: *Gaucha fasciata* Mello-Leitão 1924 (Mummuciidae) from Porto Alegre, State of Rio Grande do Sul (Mello-Leitão, 1924); *Metacleobis fulvipes* Roewer 1934 (Mummuciidae) from Cuiabá, State of Mato Grosso (Roewer 1934); *Ammotrecha friedlaenderi* Roewer 1954 (Ammotrechidae) from Mendes, State of Rio de Janeiro (Roewer 1954); an undetermined species of Ammotrechidae, from State of Roraima, Brazil (Maury 1982); and, at a later date, an undetermined

species of Ammotrechidae from Manaus, State of Amazonas (Höfer & Beck 1995).

Unfortunately, these records are mere occurrence registers; and except for the record mentioned by Höfer & Beck (1995), there is no ecological information about the species. Moreover, *Ammotrecha friedlaenderi* and *Metacleobis fulvipes* are known only from their types and the records from Roraima and Manaus are immature individuals and therefore cannot be identified at this time.

Recently, new records of Solifugae in Brazilian Amazonia and cerrado have been noted (Rocha & Canello 1997), extending the known distribution and habitats in South America, which is probably greater than present records indicate. In addition to our poor understanding of the systematics and diversity of Neotropical Solifugae, very little is known about their ecology and behavior. Most of the ecological studies on these arachnids deal

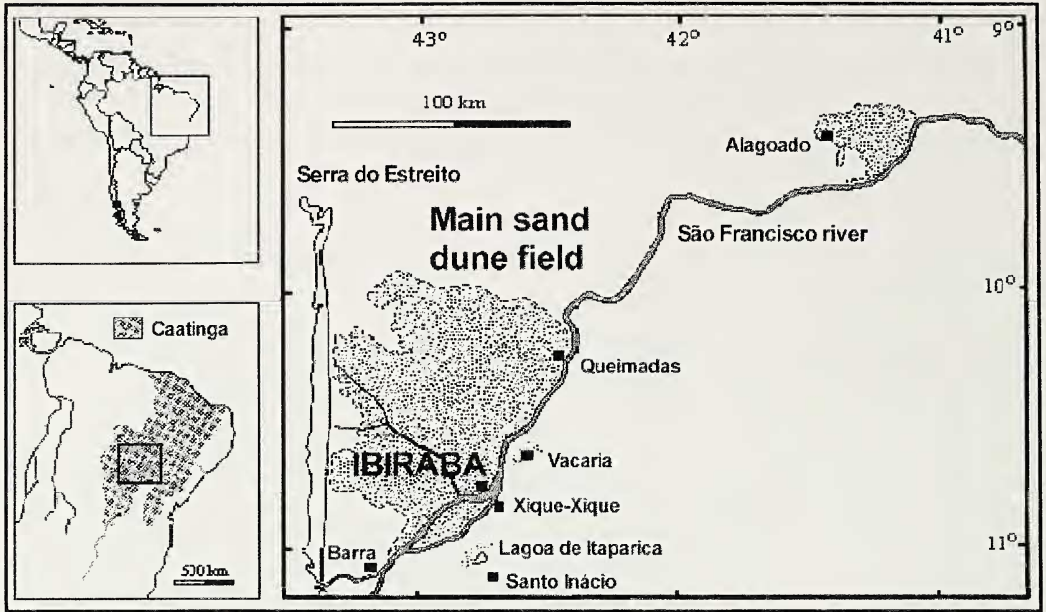


Figure 1.—Continental sand dunes of São Francisco river, Brazil, in the caatinga morphoclimatic domain showing the studied area at Ibiraba.

with North American and African species. This is the first study presenting data on the ecology of a Brazilian solifuge. In the present paper *Mummucia mauryi* new species is described from the State of Bahia, in the Brazilian semi-arid caatinga domain. Ecological data, including circadian activity, spatial distribution pattern and microhabitat preferences are discussed.

METHODS

Terminology used in the description such as “bristles,” “setae” and “spines” are used according to Muma (1951). Some of these structures, bearing a bifurcation at the tips, are called “bifid bristles,” etc. Cheliceral teeth are also named according to Muma (1951), where sizes of cheliceral teeth are ordered with Roman numerals, and size I is larger than II and so on. The tarsal spination is represented as in Roewer (1934), Muma (1951) and Maury (1970). The term “ctenidia” is used as in Maury (1984). Type material is deposited in Museu de Zoologia da Universidade de São Paulo (MZUSP), State of São Paulo, Brazil.

The study was carried out on Ibiraba—sand dunes on the northeastern Brazilian caatinga (Fig. 1). The vegetation physiognomy is described in Rocha (1991). There is a large

amount of exposed sandy soil. Nimer (1979) reported an annual mean precipitation of 692 mm. There are two distinct seasons, a dry season from April–September and a rainy season from October–April.

A grid with 128 pitfall traps covered two dune summits and two valleys during February, and a similar one with 120 traps was set in September 1996. Each trap consisted of a plastic cylindrical receptacle (30 × 40 cm) to which three drift fences (Corn 1994) 1.5 m long were radially attached. The distance between traps was 7 m. No chemicals or baits were used in the traps. The microhabitat around each trap was recorded once each month as seven variables: microgeographic position (summit, talude, plateau or valley), vegetation covering (cm² inside a 3.0 m diameter circle centered in each trap) by trees, shrubs, subshrubs, *Bromelia antiacantha* (Bromeliaceae), *Opuntia inamoena* (Cactaceae) and litter cover. The pitfalls were scanned for solpugids twice a day, around 0600 h and 1700 h. Comparing three methods of collecting solifuges, Muma (1980) suggested pitfall trapping as the most suitable method for number of individuals and species composition estimates. Pitfalls were also used

by Griffin (1990) in the Namibia desert to study microhabitat preferences, species richness and activity patterns.

For spatial distribution pattern analysis, Morisita's index of dispersion (I_d) was applied and its departure from the unity was evaluated by a chi-square test (Brower et al. 1997). The analysis on preferences by the solpugid on each microhabitat variable on ratio scale was carried out using Mann-Whitney U -test comparing the distribution of the values of each variable by the event of capture with the distribution of the same variable obtained on the entire sampling grid. Habitat preference on the categorical variable microgeographic position was checked using the goodness of fit test.

Family Mummuciidae

Mummucia mauryi new species Rocha

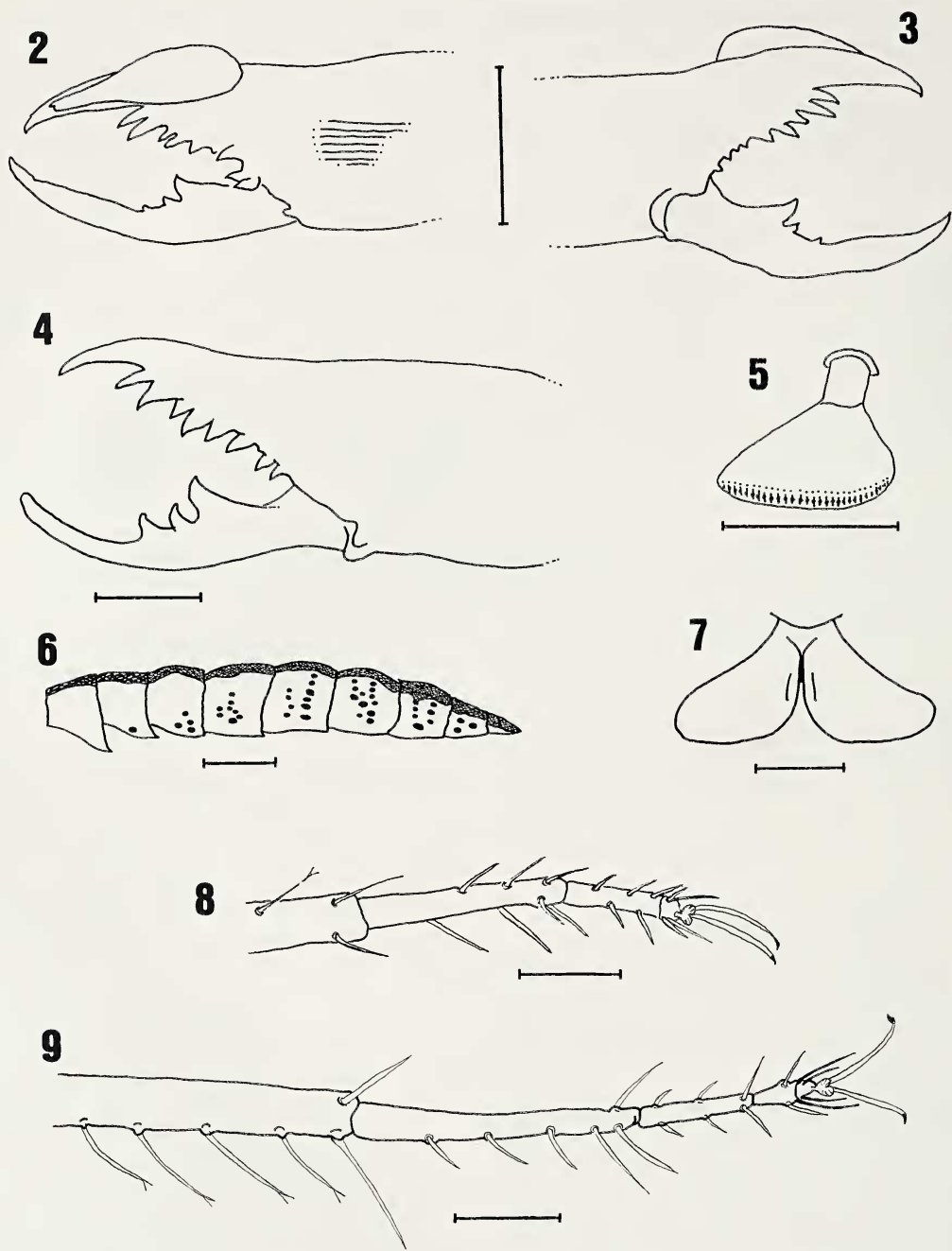
Types.—Holotype male, MZUSP 16470 (col. P. Rocha, 26 February 1996). Paratypes: 1♂ 1♀ MZUSP 15784 and 2♀ MZUSP 15932 (col. E. Xavier, February 1996); 1♂ MZUSP 16471 and 2♂ MZUSP 16472 (col. P. Rocha, 25 February 1996); 1♂ MZUSP 16473 (col. E. Xavier, 11 December 1996); 1♂ MZUSP 16474 (col. E. Xavier, 12 December 1996). All from Ibiraba, western side of São Francisco River, State of Bahia, Brazil. 10°48'S, 42°50'W.

Etymology.—The specific name is given in honor to the late Dr. Emilio Maury.

Diagnosis.—*Mummucia mauryi* is a species of Mummuciidae whose anterior tooth of the movable finger is smaller than the intermediate tooth in males and similar to intermediate in females.

Description.—*Male*: Coloration in 80% ethanol: Prosoma. Propeltidium white, central portion brown, dark brown near the lateral lobe grooves. Ocular tubercle black, with a longitudinal white narrow stripe between the eyes. Peltidium white, posterior border brown. Parapeltidium, mesopeltidium and metapeltidium similar to opisthosomal tergites. Chelicerae pale brown, three longitudinal white stripes on ectal face joined dorsally above the fondal teeth. Pedipalpi and legs brown, ventral face pale brown. Malleoli pale brown with small brown spots on distal border (Fig. 5). Opisthosoma: Lateral borders of tergites white, with wide dark brown stripe on the central half, which is darker near the posterior

border of the tergites. Brown bifid setae with brown sockets when they are in white area of the tergites, and white sockets when in the dark brown area. Pleurites (Fig. 6) white, dorsal portion dark brown. Pale brown translucent bifid bristles in the white portion have sockets shaped into dark brown spots, which are generally arranged as in Fig. 6. Sternites pale brown, lateral posterior borders brown in the four distal. First to fourth post-spiracular sternites with brown spots which include the sockets of some bifid bristles. All covering bristles and bifid bristles are translucent pale brown. *Morphology and chaetotaxy*: Prosoma: Propeltidium with some scattered bifid setae, slightly wider than long (Table 1) and separated from lateral lobes by dorsal grooves. Ocular tubercle prominent with bifid setae anteriorly oriented. Distance between two eyes about twice eye diameter. Peltidium narrow, with a transverse row of bifid setae. Parapeltidium smooth. Mesopeltidium wider than long, semicircle-shaped, with several bifid setae in the posterior border. Metapeltidium wider than long, with several bifid setae. Chelicerae (Figs. 2, 3): stridulatory apparatus on mesal face with seven parallel narrow grooves; ectal face with several short bristles and several setae, bifid or acuminate; movable finger with one anterior, one intermediate and one principal tooth, graded in size from distal to proximal III, II, I; fixed finger dentition: two anterior teeth (the first one may be vestigial), one intermediate and one principal tooth, graded in size from distal to proximal II, I, IV, III; five ectal fondal teeth, graded in size, from distal to proximal I, II, III, II, II (the 5th may be absent); three mesal fondal teeth, graded in size from distal to proximal I, II, II, the first distal separated from the others by a diastema; in the center of the dorsal face the fixed finger bears one very long seta (about the length of femur IV) with a prominent socket; flagellum (Figs. 2, 10) thin, translucent drop-shaped vesicle, laterally flattened and with a longitudinal ectal opening (in the face adjacent to the chelicera), which extends from near the attachment base to the tip of the flagellum. The attachment base of the flagellum is a sclerotized ring placed posteriorly in its ectal face. Pedipalp: tarsi immovable, without spines, densely covered by differentially sized bifid bristles, with some very long setae in metatarsi and tibiae (about twice the length



Figures 2-9.—*Mummucia mauryi* new species. 2. Male right chelicera, mesal view; 3. Male right chelicera, ectal view; 4. Female left chelicera, ectal view; 5. Male right malleolus V; 6. Male left pleurites; 7. Female genital sternite; 8. Female left leg III; 9. Male right leg IV.

of pedipalpal tibia). Legs: with several differentially-sized bifid bristles and some bifid setae. Some very long setae in dorsal surface (about twice the length of metatarsus IV). Leg I thin, without claws and spines. Legs II and

III (see female leg III, Fig. 8): tibiae with 1 or 1.1 ventral bifid spines and a distal pair of ventral spines; metatarsus with three retrolateral spines and 1.1.2 ventral spines; tarsi two-segmented with 1.2.2/1.2 or 1.2.2/2.2 ventral

Table 1.—Morphometric characters of *Mummucia mauryi* new species. Measurements are in millimeters (except propeltidium length/width ratio) and were recorded as described in Muma (1951).

Morphometric character	Male holotype (MZUSP 16470)	Range among males (7 individuals)	Female paratype (MZUSP 15932)	Range among females (3 individuals)
Total length	7.55	7.10–8.10	11.20	8.55–11.20
Cheliceral length	1.71	1.70–1.80	2.60	1.75–2.60
Cheliceral width	0.50	0.50–0.61	0.88	0.60–0.88
Propeltidium length	1.15	1.11–1.30	1.47	0.99–1.47
Propeltidium width	1.35	1.32–1.40	2.05	1.35–2.05
Propeltidium length/ width ratio	0.85	0.84–0.93	0.72	0.71–0.73
Pedipalp	4.80	4.45–4.90	5.70	3.90–5.70
Leg I	4.00	3.20–4.20	4.90	3.40–4.90
Leg IV	7.40	6.20–8.40	9.50	5.50–9.50

spines. Leg IV (Fig. 9): tibia with an anterior row of 1.1.1.1 ventral bifid spines and a distal pair of ventral spines; metatarsus with 1.1.1.1.2 ventral spines; tarsi three-segmented, with 2.2.2/2/1.2 or 2.2.2/2/2.2 ventral spines. Malleoli as in Fig. 5. Opisthosoma: Tergites wider than long, with rounded borders, covered by bifid setae and bifid bristles. Sternites wider than long, densely covered by bifid bristles. Genital operculum with central longitudinal opening. Posterior border of 2nd post-spiracular sternite with a row of about 50 ctenidia, more rigid and slightly longer than the bifid bristles in sternites. Morphometric characters in Table 1.

Female: Similar to male, but with the following particular features. Coloration in ethanol 80% similar to male, but with lighter tonalities. *Morphology and chaetotaxy*: Prosoma: Propeltidium wider than long with numerous bifid setae and small bifid bristles. Eyes separated by three times the eye diameter. Chelicerae (Fig. 4): movable finger with one anterior, one intermediate and one principal tooth graded in size from distal to proximal II, II, I. Fixed finger with two anterior teeth, one intermediate and one principal, graded in size from distal to proximal I, I, III, II (the first anterior may be slightly smaller than the 2nd). Five ectal fondal teeth graded in size from distal to proximal I, I, IV, II, III (the 3rd may be vestigial). Mesal fondal teeth as in male. Leg III similar to male (Fig. 8). Leg IV: tibia with an anterior row of 1.1.1 or 1.1.1.1 ventral bifid spines and a distal pair of ventral spines; metatarsus with 1.1.2 or 1.1.1.2 ventral spines. Opisthosoma. Sternites densely and

uniformly covered by bifid bristles, without conspicuous sockets. Genital operculum prominent, fan-shaped, round-bordered, with central longitudinal opening (Fig. 7). Posterior border of 2nd post-spiracular sternite with a row with several ctenidia, slightly longer than the bifid bristles of the sternites. Morphometric characters in Table 1.

Systematic comments.—There is no consensus about the number and the systematic position of genera of the family Mummuciidae. For instance, Muma (1976) recognizes 11 genera in Mummuciidae (six of them monotypic), whereas Maury (1984) has transferred three of these genera to the family Ammotrechidae. The typical genus *Mummucia* Simon 1879 has only three species, which are known only by females (Muma 1976) and one of them (*Mummucia patagonica* Roewer 1934) should be transferred to family Ammotrechidae, since this species bears spines at the pedipalpal metatarsi, a distinctive character of this family. According to Maury (pers. comm. 30 December 1997, 1998), there is no good character to distinguish the genera of Mummuciidae, so that the most conservative decision is to consider the new Mummuciidae species herein described as belonging to the typical genus *Mummucia*, until more precise information about the taxonomy and phylogeny of the group become available.

The shape of the flagellum is a good character for the definition of Neotropical families and in Mummuciidae the flagellum is vesicular (Maury 1984). The flagellum of *M. mauryi* new species bears a longitudinal ectal opening, which has not been reported in other

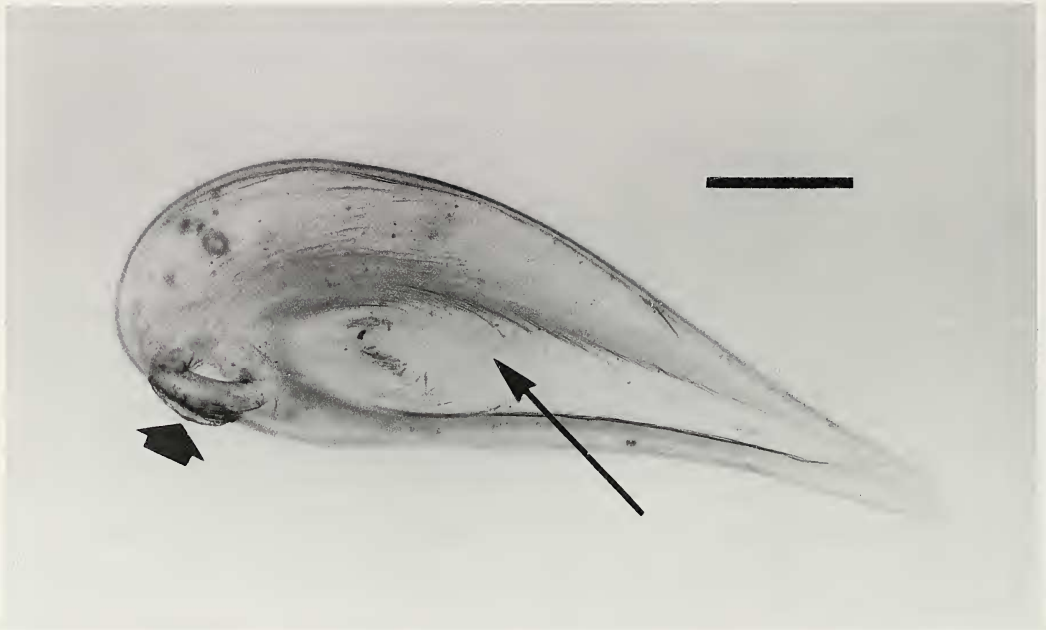


Figure 10.—Photomicrograph of the flagellum of *Mummucia mauryi* new species, showing the longitudinal lateral opening in the face adjacent to chelicerae, indicated by the long arrow. The short arrow indicates the attaching ring. Scale = 0.1 mm.

Mummuciidae species. Therefore this character may be useful in further studies on the systematics of Mummuciidae.

AUTOECOLOGY

Specimens of *Mummucia mauryi* new species represented 5% of all arachnid specimens collected by the pitfall trap method described above (Xavier & Rocha 1998): 22 specimens were collected in February (rainy season) and 88 in September (dry season). The traps examined during the morning showed no solifuges. This agrees with Maury (1984), who predicted that mummuciids should be the only South American solifuges with diurnal habits. Indeed, Cloudsley-Thompson (1977, 1978) suggested that *Mummucia variegata* (Gervais) 1849 is a diurnal species, and that diurnal activity is exhibited by smaller and brightly-colored solpugid species. On the other hand, Wharton (1987) states that "there are several large, diurnal solifuge species in the arid regions of southern Africa." *Mummucia mauryi* new species agrees with both Cloudsley-Thompson and Maury predictions, being a brightly-colored, small and diurnal mummuciid species. Because solifuges are "unusually tolerant of high temperature (...) and have

very low transpiration rates (...), it seems probable that the avoidance of predators may be of greater significance than thermal physiological requirements in their night-active behavior" (Cloudsley-Thompson 1991). Following this idea, we should expect diurnal solifuges to exhibit additional mechanisms of predator avoidance.

As discussed below, the analyses performed detected preferences only twice for microhabitat variables and once for microgeographic region. There was detected a positive preference for areas covered by *Opuntia inamoena* (Cactaceae) during the dry season ($U = 4592$, $P = 0.03$). The African solpugid *Lipophaga trispinosa* Purcell 1903 is restricted to low plant cover areas during dry periods (Dean & Griffin 1993). They also found a low diversity of solifuges associated with loose sand soil. For *Eremobates marathoni* Muma 1951, Punzo (1998) detected a preference for sandy soils, open areas and scattered clumps of vegetation, and he suggested that "scattered clumps of vegetation afford cover and protection from predators (...) including night hawks, roadrunners, scorpions, and other solifuges." In fact, *Opuntia inamoena* is an in-

hospitable spiny plant, which may be avoided by many possible predators such as diurnal birds. Nevertheless, a parallel study on lizards at the same area was carried out by Rocha (1998) showing preference for *O. inamoena* by the lizard *Tropidurus psammonastes* (Tropiduridae). The lizard's diet includes mainly ants and insect larvae, and solifuges are rarely preyed on, as one only event was recorded.

"The avoidance of open areas devoid of vegetation appears to be a rather common trait in solifuges" (Punzo 1998). This seems to be the case to *Mummucia mauryi* new species. During the dry season it showed a negative preference for dune summits ($\chi^2 = 9.74$, $0.025 < P < 0.05$) and areas covered by heliophylic subshrubs ($U = 4212$, $P = 0.009$), which is here interpreted as avoidance of sun-exposed areas, which may be associated with avoidance of predators and/or environmental extremes.

Morisita's index was 3.32 ($\chi^2 = 175.818$, $0.005 > P > 0.001$) in the rainy season and 1.38 ($\chi^2 = 151.209$, $0.025 > P > 0.01$) in the dry season, indicating a clumped distribution through the year. Investigating the eremobatid solifuge *Eremobates palpisetulosus* Fichter 1941, Punzo (1997) found a clumped dispersion pattern, without significant differences in adult dispersion as a function of sex or season.

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